#43

# INSTRUCTION MANUAL

## REGULATED POWER SUPPLIES

100 amp. +5V
For Test

LGS-EE SERIES

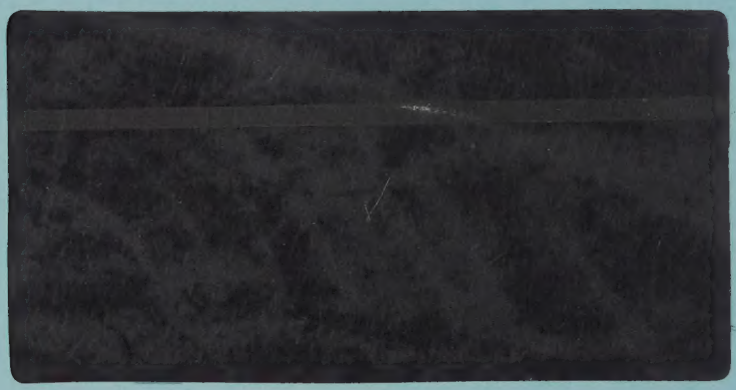
This manual applies to units
bearing serial no. prefixes A - G.

slate 5

LAMBDA

9100

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.



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This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LGS-EE models unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LGS-EE

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## SPECIFICATIONS AND FEATURES

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

| MODELS | VOLTAGE RANGE | MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE | | | |
|---|---|---|---|---|---|
| | | 40°C | 50°C | 60°C | 71°C |
| LGS-EE-5-OV-R | 5 ± 5% | 110.0 | 100.0 | 86.0 | 72.0 |
| LGS-EE-6-OV-R | 6 ± 5% | 100.0 | 90.0 | 80.0 | 65.0 |
| LGS-EE-12-OV-R | 12 ± 5% | 60.0 | 53.0 | 46.0 | 38.0 |
| LGS-EE-15-OV-R | 15 ± 5% | 47.0 | 42.0 | 36.0 | 30.0 |
| LGS-EE-20-OV-R | 20 ± 5% | 34.0 | 30.0 | 26.0 | 22.0 |
| LGS-EE-24-OV-R | 24 ± 5% | 30.0 | 27.0 | 23.0 | 19.0 |
| LGS-EE-28-OV-R | 28 ± 5% | 25.0 | 23.0 | 20.0 | 16.0 |

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range. Derate output current rating 10% for 187-242 VAC ("V" option) input.

REGULATED VOLTAGE OUTPUT

Regulation ..... 0.1% line or load with input variations from 105-132 or 132-105 volts AC and load variations from no load to full load.

Ripple and Noise ..... 10mV RMS, 35mV peak-to-peak for LGS-EE-5-OV-R,-6-OV-R models; 15mV RMS, 100mV peak-to-peak for LGS-EE-12-OV-R, -15-OV-R, -20-OV-R, -24-OV-R, and -28-OV-R with either positive or negative terminal grounded.

Temperature Coefficient ..... Change in output voltage 0.03%/°C max.

Remote Programming

External Resistor ..... Nominal 1000 ohms/volt output.

Programming Voltage ..... One-to-one voltage change.

Remote Sensing ..... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

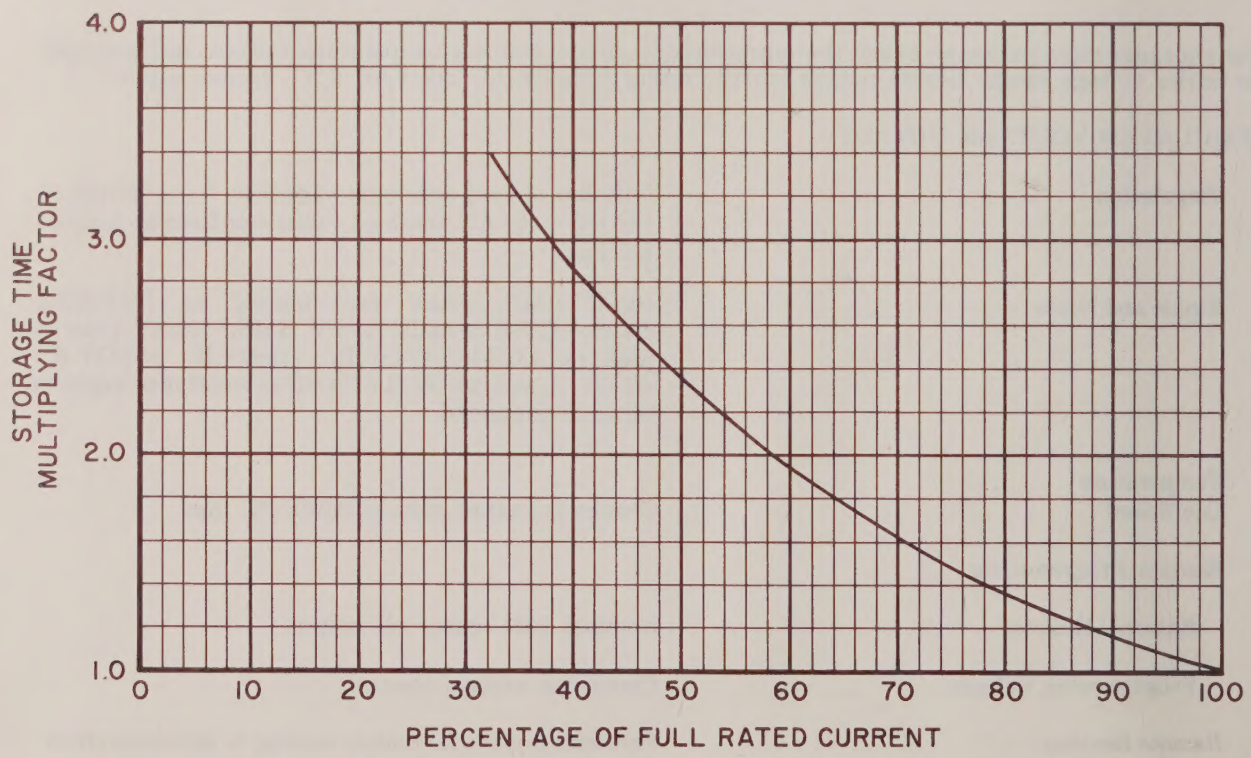
STORAGE TIME — Determine storage time regulation after input power failure as follows:

1. Find storage time at full rated current from chart below.
2. Determine percentage of full rated current for desired application.
3. Find multiplying factor on graph below.
4. Apply storage time formula:

$$S = (F)\ (M)$$

where S = storage time
F = storage time at full rated current (see chart)
M = multiplying factor (see graph)

| MODEL | STORAGE TIME (ms) AT FULL RATED CURRENT |
|---|---|
| LGS-EE-5-OV-R | 16.5 |
| LGS-EE-6-OV-R | 9.4 |
| LGS-EE-12-OV-R | 9.3 |
| LGS-EE-15-OV-R | 8.3 |
| LGS-EE-20-OV-R | 5.0 |
| LGS-EE-24-OV-R | 2.5 |
| LGS-EE-28-OV-R | 7.0 |



AC INPUT — 105-132, 205-265 or 187-242 ("V" option) VAC at 47-440 Hz.
Input power: 1100 Watts*. Input current: 14.0 amps**. For operation at frequencies above 440 Hz, consult factory.

*With output loaded to full current rating.
**With output loaded to full current rating and input voltage 105 VAC, 60 Hz.

INPUT FUSE — Fuse F1 protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal ..... Thermostat resets automatically when over-temperature condition is eliminated.

Electrical

External ..... Automatic electronic current limiting circuit, limits output current to a preset safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

Internal ..... Fuse F2 provides protection against internal circuit failure.

OVERVOLTAGE PROTECTION — All LGS-EE models include fixed built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table below for overvoltage protector firing ranges.

| MODEL | OVERVOLTAGE PROTECTOR TRIP-POINT RANGE (VOLTS) |
|---|---|
| LGS-EE-5-OV-R | 6.3 — 6.7 |
| LGS-EE-6-OV-R | 7.2 — 7.6 |
| LGS-EE-12-OV-R | 13.3 — 14.3 |
| LGS-EE-15-OV-R | 16.5 — 17.5 |
| LGS-EE-20-OV-R | 22.1 — 23.5 |
| LGS-EE-24-OV-R | 26.5 — 28.1 |
| LGS-EE-28-OV-R | 30.9 — 32.9 |

INPUT CONNECTIONS — Terminal block on rear of chassis.

OUTPUT CONNECTIONS — 1/4-28 studs on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non operating) — -55°C to 85°C

FUNGUS — All LGS-EE power supplies are fungus inert.

VDC ADJ. Control — Voltage adjust control permits adjustment of DC output over entire operating range.

PHYSICAL DATA

| | |
|---|---|
| Size | 7-1/2" x 4-15/16" x 16-1/2" |
| Weight | 26 lbs. net; 31 lbs. shipping |
| Finish | Gray, FED. STD. 595 No. 26081 |

MOUNTING — One surface with tapped mounting holes can be utilized for mounting this unit. LGS-EE power supplies must be mounted with Top facing up. Top must be in a horizontal plane. Refer to figure 10 for mounting details.

"V" OPTION — Standard LGS-EE power supplies can be obtained for 205-265 VAC input or 187-242 VAC input. See nameplate for AC input rating. Derate output current rating 10% for 187-242 VAC input. For operation at frequencies above 440 Hz, consult factory.

ACCESSORIES

| | |
|---|---|
| Rack adapters | Rack adapter LRA-11 used for ruggedized mounting with or without chassis slides, is available. |

## THEORY OF OPERATION

### GENERAL

The Lambda power supply consists of an input circuit; an auxiliary rectifier and filter; a main output rectifier; and a main regulator circuit consisting of timing oscillator, flip-flop, comparator, nor gates, control and current limit amplifiers, and pulse width modulated inverter.

The circuit arrangement is shown in block diagram form in figure 8. The circuitry is discussed with reference to the block diagram and the schematic diagram.

### FUNCTIONAL DESCRIPTION

#### Input Circuit

Single phase AC input power is applied to silicon control rectifiers SCR5, SCR6 via EMI suppression network C20, C21, C18, C16, C27, C28, L3, L4, L5. Fuse F1 protects the power supply against excessive currents due to internal failure.

The input rectifier and voltage doubler capacitors C1, C2 provide power via center tap of T1, R2, R1, CR104, and CR129 for the logic circuitry and provide power to the pulse width modulated inverter.

On initial turn-on, capacitors C1, C2 are charged via CR103, R15 and CR144, R16. Capacitor C107 is charged via R113. When the voltage on C107 exceeds the zener breakdown voltage of CR141, CR141 conducts, turning on control amplifier HC101 which, in turn, turns on the pulse width modulated inverter. The pulse width modulated inverter supplies gate voltage to SCR5 and SCR6 via CR5 and CR6. This action serves to prevent excessive in-rush current when unit is turned on.

#### Pulse Width Modulated Inverter

Positive and negative pulses are provided to the primary of T1 by the alternate conduction of Q1, Q3 and Q2, Q4. The duration of these pulses is determined by the conduction time of Q1, Q2, Q3, and Q4. This time is determined by the duration of the drive pulses applied to the bases of Q101 and Q102 by IC103.

When Q101 is turned on, voltage will be applied to the base of Q1 via C125, CR105, R204, CR108, CR110, and CR114 turning Q1 on. Current flow through T203A causes a voltage to be developed across T203B. This voltage turns on Q3. The voltage developed across T203C compensates for the loss of drive due to the voltage across T203A. As current through C125 decays, regenerative action holds Q1 on by providing base drive via CR10, CR9, R10, feedback winding of T1, CR115, and CR114. Diode CR118 prevents saturation of Q1 which would extend turn-off time. Resistor R101 provides sufficient current to keep Q103 and Q105 off.

When Q101 is turned off, C105 provides voltage to turn on Q103 which, in turn, turns on Q105. Bias circuit C101, Q107, CR128, C106 supplies negative bias to the base of Q1 via Q105, CR145, and R140. This action rapidly turns off Q1 and holds it off.

A similar sequence of events serves to turn Q2 and Q4 on and off as Q102 is turned on and off.

#### Output Circuit

Positive and negative pulses supplied by T1 secondary are rectified by full wave rectifiers CR1 through CR4; filtered by filter network C3, L1 and supplied to the output via E.M.I. suppression network C8, C9, C13, C14, L2, L9, L10, L11, L12.

## Logic and Control Circuits

IC101 is a free running timing oscillator. The output, pin 3, of IC101 is high for 23 microseconds and low for 5 microseconds resulting in an overall period of 28 microseconds. The output of IC101 is fed into flip-flop IC102. IC102 is triggered by the leading edge of the IC101 output resulting in square waves having period of 56 microseconds at the Q and $\overline{Q}$ (pins 1 and 2) outputs of IC102. Each square wave serves as one input to one of two nor gates located within IC103. The other input of each gate is provided by internal circuitry withi IC103 connected as an amplitude comparator at pin 1 of IC103. Pin 1 of IC103 is controlled by the output of the hybrid control amplifier HC101.

HC101 control output is determined by changes in output voltage as sensed via L7, voltage control R19, and resistor R119. If the output voltage tends to decrease, current from pin 6 output of HC101 is delayed thereby delaying the charging of C119 and delaying the high input to pin 1 of IC103. This action delays the turning off of the drive output to Q101 or, as applicable Q102. When IC101 pin 3 goes low, the voltage at IC103 pin 1 is reset via CR126. The connection from IC101 pin 3 to IC103 pins 5 and 6 via CR127 serves to prevent Q101 and Q102 from being turned on while the timing oscillator is in the low state. This sequence is shown in the following truth table:

| IC101 | IC102 | | IC103 | | | REMARKS |
|---|---|---|---|---|---|---|
| TIMING OSCILLATOR | FLIP-FLOP OUTPUTS | | INPUT | DRIVE OUTPUTS | | |
| Pin 3 | Pin 1 | Pin 2 | Pin 1 | Pin 10 | Pin 11 | |
| low | low | high | low | low | low | inverter dead period |
| high | low | high | low | high | low | drive Q101 |
| high | low | high | high | low | low | inverter quiescent period |
| low | high | low | low | low | low | inverter dead period |
| high | high | low | low | low | high | drive Q102 |
| high | high | low | high | low | low | inverter quiescent period |
| low | low | high | low | low | low | inverter dead period |

## Current Limit Operation

As the load current tends to increase, the inverter current increases, thereby increasing the voltage across resistor R5. This voltage is sensed by hybrid control amplifier HC101. The result is the progressive hastening of the current output from HC101 pin 6 and therefore, drive current to Q101 or, as applicable, Q102 is turnec off sooner and sooner until the conduction time of the inverter becomes less than 3 microseconds.

As load impedance approaches short circuit the load current is held relatively constant.

## Overvoltage Circuit Operation

When the output voltage reaches the trip-point of the hybrid overvoltage module, the module fires crow-barring the output of the supply. The current through the module is sensed by current sensor L8. The outpu of L8 triggers SCR101, crow-barring the logic circuitry and turning the inverter off.

## BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When rated load current is exceeded, voltage decreases towards zero and the current at short circuit is held to a safe value.

## CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded AC lead to terminal 1.

The supply positive terminal is brought out to terminal 6. The supply negative terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

## SUPPLY LOAD CONNECTIONS

### Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LGS-EE power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

## OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the main rectifier heat radiator exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown. When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply and SCR101 will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by interrupting the AC input circuit for a period of 30 seconds. (Refer to TROUBLE SHOOTING CHART)

## GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

## TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 8, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

## CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

## PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact, but not covered with solder, it is a good contact. Do not attempt to cover with solder.
2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.
3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.
4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.
5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:
   a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.
   b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

## TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

## SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

## TROUBLE SHOOTING CHART

| Symptom | Possible Cause | Remedy |
|---|---|---|
| 1. Zero volts DC output, voltages across C1 and C2 read zero. | Open F1<br>CR7, CR8, SCR5, SCR6. | Check and replace as necessary. |
| 2. Same as 1, voltages across C1 and C2 are correct, voltage across C104 is zero. | Thermostat S1 closed. | Refer to table 1 of SPECIFICATIONS AND FEATURES for current ratings at given ambient temperature. After allowing time for the power supply to cool, resume operation of the supply. |

## TROUBLE SHOOTING CHART

| Symptom | Possible Cause | Remedy |
|---|---|---|
| | SCR101 fired due to OV condition | Interrupt AC input for 30 seconds. If supply operates normally, a transient has occurred in line or load, check wiring (switches, etc.). If supply fails to reach full output voltage, remove AC input, disconnect +V terminal of HC1, remove load, apply AC power and refer to procedure for: Output Too High "Symptom 4." |
| | R1 or R2 open, CR129 shorted. | Check and replace as necessary. |
| 3. Same as 1, voltages across C1, C2, and C104 are correct. | Q1, Q2, Q3, Q4, F2, R5 open. | Check and replace as necessary. |
| 4. Output voltage too high. | Open sense lead. | Check load and load connections, correct as necessary. |
| | Defective HC101. Open R119, R124, R130, CR122 — CR125 | Check and replace as necessary. |
| 5. Very low output voltage, voltage across C104 reads correct | R126, R127 open. HC101, SCR101 defective | Check and replace as necessary |
| 6. High ripple | Defective HC101 | Replace as required. |

## PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 9. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

## ADJUSTMENT OF CALIBRATION CONTROL R125.

Whenever HC101, R5, or R125 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R125 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30° C, and is stabilized and not operating.

1. Remove AC input power to the supply.
2. Break seal on wiper of R125 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load, and with AC input of 132 VAC, 60 Hz.
4. Turn voltage adjust control until minimum rated output voltage is obtained.
5. Apply load so that output current is 110-115% of 40° C rating for the unit.

6.* Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple increases sharply and the unit emits an audible noise. Readjust R125 in CW direction until output ripple is restored to its original value and the noise ceases.

7.* After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.

8.* After sealing, check setting and repeat adjustment procedure if required.

* Perform alternate steps 6A through 8A for adjustment of R125 on models LGS-EE-5-OV-R and LGS-EE-6-OV-R.

6A. Using oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple increases sharply and oscilloscope pattern changes.

7A. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.

8A. After sealing, check setting and repeat adjustment procedure if required.

## SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

## PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

# PARTS LIST

The electrical parts located on Lambda models LGS-EE-5-OV-R — LGS-EE-28-OV-R are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common parts listing. In addition there is a separate listing of parts for the "V" option.

## COMMON PARTS

### MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| C1, C2 | Cap., elect., 2,900 mf -10 +100%, 200 vdc | CBS-29-136 |
| C4 | Cap., ceramic, 0.02 mf ±20%, 1,400 vdc | CDL-20-003 |
| C5 thru C7 | Cap., ceramic, 0.002 mf ±10%, 3,000 vdc | CDK-20-015 |
| C8 | Cap., ceramic, 0.01 mf ±20%, 500 vdc | CDM-10-002 |
| C9 | Cap., polycarbonate, 0.47 mf ±20%, 300 vdc | CGM-47-028 |
| C10, C11 | Same as C4 | |
| C12 | Cap., elect., 33 mf -10 +75%, 50 vdc | CBP-33-040 |
| C13 | Same as C8 | |
| C14 | Same as C9 | |
| C15 | Same as C5 | |
| C16 | Same as C4 | |
| C17 | Not assigned | |
| C18 | Cap., paper, 0.15 mf ±10%, 400 vdc | CAM-15-017 |
| C19 | Same as C8 | |
| C20, C21 | Same as C5 | |
| C22,+ C23+ | Cap, mylar, 0.047 mf ± 10%, 200 vdc | CGL-47-018 |
| C24 | Cap., elect., 3.3 mf ±20%, 35 vdc | CBN-33-019 |
| C25 | Cap., ceramic, 0.01 mf ±20%, 1,000 vdc | CDL-10-004 |
| C26** | Same as C8 | |
| C27, C28 | Cap., ceramic, 0.01 mf -20 +80%, 3,000 vdc | CDL-10-014 |
| C29, C30 | Not assigned | |
| C31* thru C34* | Cap., ceramic, 470 pf ±20%, 1,000 vdc | CCJ-47-004 |
| C101 | Cap., elect., 40 mf -10 +100%, 60 vdc | CBP-40-047 |
| C102 | Cap., elect., 50 mf -10 +100%, 40 vdc | CBP-50-064 |
| C103, C104 | Same as C24 | |
| C105 | Cap., mylar, 0.22 mf ±10%, 80 vdc | CGM-22-004 |
| C106 | Cap., elect., 60 mf -10 +100%, 12 vdc | CBP-60-095 |
| C107 | Cap., elect., 3.5 mf -10 +100%, 400 vdc | CBN-35-035 |
| C108 | Not assigned | |
| C109† | Cap., mylar, 0.22 mf ±10%, 80 vdc | CGM-22-004 |
| C110 | Cap., mylar, 0.1 mf ±10%, 80 vdc | CGM-10-006 |

+ C22, C23 not used on units with serial no. prefixes A-E.

## COMMON PARTS (Cont.)

### MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| C113 thru C116 | Not assigned | |
| C117 | Cap., mylar, 0.01 mf ±10%, 200 vdc | CGL-10-002 |
| C118 | Cap., mica, 0.0018 mf ±2%, 500 vdc | CCK-18-003 |
| C119, C120 | Cap., mica, 100 pf ±5%, 500 vdc | CCJ-10-007 |
| C121 | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| C122 | Not assigned | |
| C123 | Cap., mylar, 0.1 mf ±10%, 80 vdc | CGM-10-006 |
| C124 | Cap., mylar, 0.47 mf ±10%, 200 vdc | CGM-47-016 |
| C125,* C126* | Cap., mylar, 0.068 mf ±10%, 200 vdc | CGL-68-003 |
| C127 | Cap., mica, 680 pf ±10%, 300 vdc | CCJ-68-006 |
| C128 | Same as C118 | |
| C201 thru C221 | Not assigned | |
| C222, C223 | Cap., elect., 10 mf ±20%, 10 vdc | CBP-10-027 |
| CR5, CR6 | Rectifier | FBL-00-103 |
| CR7, CR8 | Rectifier | FBL-00-052 |
| CR9, CR10 | Rectifier | FBL-00-039 |
| CR11, CR12 | Rectifier | FBL-00-105 |
| CR101,†† CR102†† | Same as CR5 | |
| CR103 | Rectifier | FBL-00-066 |
| CR104 | Not assigned | |
| CR105, CR106 | Same as CR11 | |
| CR107 thru CR111 | Rectifier | FBL-00-082 |
| CR112,† CR113,† | Same as CR5 | |
| CR114 thru CR117 | | |
| CR118 thru CR121 | Same as CR11 | |
| CR122 thru CR125 | Same as CR5 | |
| CR126, CR127 | Same as CR107 | |
| CR128† | Rectifier, zener diode | FBM-Z103 |

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| CR129 | Rectifier, zener diode | FBM-Z112 |
| CR130 | Not assigned | |
| CR131, CR132 | Same as CR11 | |
| CR133 thru CR140 | Not assigned | |
| CR141 | Rectifier, zener diode | FBM-Z126 |
| CR142† | Rectifier | FBL-00-121 |
| CR143 | Not assigned | |
| CR144 | Same as CR103 | |
| CR145,† CR146† | Same as CR5 | |
| CR147 | Rectifier | FBL-00-064 |
| CR149 | Not assigned | |
| CR150* thru CR153* | Rectifier | FBL-00-030 |
| CR201,†† CR202†† | Same as CR5 | |
| CR203 thru CR210 | Not assigned | |
| CR211, CR212 | Same as CR5 | |
| CR213 | Rectifier, zener diode | FBM-Z133 |
| CR214 thru CR219 | Not assigned | |
| CR220 thru CR223 | Same as CR150 | |
| F1** | Fuse, 25A, 3AB, NORM-BLO | FFJ-25-000 |
| F2 | Fuse, 8A, 3AB, NORM-BLO | FFJ-08-000 |
| HC101 | Hybrid regulator | FBH-00-002B |
| IC101 | Integrated circuit | FBT-00-042 |
| IC102 | Integrated circuit | FBT-00-043 |
| IC103 | Integrated circuit | FBT-00-044 |
| L2 | Toroid | TCT-117-017 |
| L3 | Choke, AC | BBA-GSEE-3 |
| L4 | Choke, AC | BBA-GSEE-2 |
| L5 | Choke, AC | BBA-GSEE-6 |
| L6 | Not assigned | |
| L7 | Choke, output sense | BBA-GS5-4 |
| L8 | Choke, 0 V | BBA-GSEE-5 |
| L9 thru L12 | Toroid | TCT-027-003 |
| L101, L102 | Not assigned | |
| L103 | Choke, current sense | BBA-GSEE-1 |
| Q1* ++ thru Q4* ++ | Transistor, NPN | FBN-L200 |
| Q101, Q102 | Transistor, NPN | FBN-L177 |
| Q103, Q104 | Transistor, PNP | FBN-L176 |
| Q105, Q106, Q107† | Transistor, PNP | FBN-L175 |
| R1, R2 | Res., ww, 2,000 ohms ±3%, 25 w | DFS-20-089 |
| R4 | Not assigned | |
| R5 | Res., ww, 0.4 ohm ±3%, 30 w | DFM-40-089 |

++Q1 thru Q4 are FBN-L195 on units with serial no. prefixes B-F. R17, R18 are 100 ohms ±10% 1/2w comp. on units with serial no. prefixes A-F.

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| R6 | Not assigned | |
| R7, R8 | Res., ww, 50 ohms ±3%, 20 w | DFP-50-043 |
| R11 thru R14 | Not assigned | |
| R15, R16 | Res., ww, 6 ohms ±3%, 40 w | DFN-60-094 |
| R17,++ R18 | Res., ww, 300 ohms ±3%, 2W | DFR-30-040 |
| R20, R21+ | Res., ww, 300 ohms ±3%, 2w | DEB-1011 |
| R101,* R102* | Res., comp., 330 ohms ±10%, ¼ w | DCB-3311 |
| R103 | Res., comp., 10,000 ohms ±10%, ¼ w | DCB-1031 |
| R104, R105 | Res., comp., 6,200 ohms ±5%, ¼ w | DCB-6225 |
| R106 | Res., comp., 100 ohms ±10%, ¼ w | DCB-1011 |
| R107 | Res., comp., 47 ohms ±10%, ¼ w | DCB-4701 |
| R109 | Not assigned | |
| R111 | Res., comp., 10,000 ohms ±10%, ½ w | DEB-1031 |
| R112 | Res., comp., 4,700 ohms ±10%, ½ w | DEB-4721 |
| R113 | Res., comp., 27,000 ohms ±10%, ½ w | DEB-2731 |
| R114 | Res., comp., 150,000 ohms ±5%, 1 w | DGB-1545 |
| R115 | Not assigned | |
| R116 | Res., comp., 180 ohms ±5%, 1 w | DGB-1815 |
| R117 | Res., film, 14,300 ohms ±1%, ½ w | DCT-14-091 |
| R118 | Res., film, 2,490 ohms ±1%, ½ w | DCS-25-037 |
| R121,†† R122†† | Res., comp., 1.0 ohm ±10%, ½ w | DEB-10G1 |
| R123, R124 | Not assigned | |
| R125 | Res., var., cermet, 2,000 ohms ±10%, 1 w | DRS-20-018 |
| R126 | Res., comp., 2.7 ohms ±10%, ½ w | DEB-27G1 |
| R127 | Same as R17 | |
| R128 | Not assigned | |
| R129 | Same as R116 | |
| R130 | Res., ww, 1,200 ohms ±3%, 3 w | DFS-12-016 |
| R135† | Res., comp., 220 ohms ±10%, ½ w | DEB-2211 |
| R136 | Res., comp., 100,000 ohms ±10%, ½ w | DEB-1041 |
| R138, R139 | Not assigned | |
| R140,† R141† | Res., comp., 3.3 ohms ±10%, ½ w | DEB-33G1 |
| R201 thru R203 | Not assigned | |
| R204 | Res., comp., 220 ohms ±10%, ¼ w | DCB-2211 |
| R205 | Not assigned | |
| R206 | Same as R204 | |
| R207 thru R212 | Not assigned | |

+R20, R21 not used on units with serial no. prefixes A-E. R20, R21 are 100 ohms ±10% 1/2w comp. on units with serial no. prefix F.

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| R213, R214 | Res., comp., 100,000 ohms ±10%, 1 w | DGB-1041 |
| R215 thru R220 | Not assigned | |
| R221,†† R222†† | Same as R121 | |
| S1 | Thermostat | FKA-110-026 |
| SCR1 thru SCR4 | Not assigned | |
| SCR5, SCR6+ | Rectifier, silicon controlled | FBP-00-037 |
| SCR101 | Rectifier, silicon controlled | FBP-00-045 |
| T201 | Not assigned | |
| T202, T203 | Transformer | ABA-GSEE-1 |
| XF1 | Fuse clips (2 req'd) | HRM-00-010 |
| XF2 | Fuseholder | HRM-00-009 |

* On units with serial no. prefix A: C125, C126 are 0.047 mf 80 vdc, CGL-47-013; Q1 thru Q4 are FBN-L178; R101, R102 are 470 ohms, DCB-4711; C31 thru C34, CR150 thru CR153 are not used.

† Only used on units with serial no. prefix A.

** On units with serial no. prefixes A—C, F1 is 20A, FFJ-20-000. C26 only used on units with serial no. prefixes A—C.

†† CR101, CR102, CR201, CR202, R121, R122, R221, R222 are not used on units with serial no prefixes A—D & G.

\+ SCR-5, SCR-6 are FBP-00-046 on units with serial no. prefixes A—E.

UNIQUE PARTS

MODEL LGS-EE-5-OV-R

| | | |
|---|---|---|
| C3 | Cap., elect., 100,000 mf -10 +50%, 7.5 vdc | CBV-10-003 |
| C111, C112 | Not assigned | |
| C121 | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-119 |
| CR148 | Not assigned | |
| HC1 | Hybrid circuit | L-20-OV-5 |
| L1 | Filter choke | BBA-LGSEE-5 |
| R3 | Res., comp., 12 ohms ±10%, 1 w | DGB-1201 |
| R9 | Res., ww, 25 ohms ±3%, 5w | DFP-25-066 |
| R10 | Res., ww, 16 ohms ±5%, 40 w | DFP-16-055 |
| R19 | Res., var., cermet, 5,000 ohms ±20%, 1 w | DRS-50-010 |
| R108 | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110†† | Res., comp., 22,000 ohms ±10%, ¼ w | DCB-2231 |
| R119 | Not assigned | |
| R120 | Res., film, 20 ohms ±5%, ½ w | DCP-20-026 |
| R131 thru R134, R137 | Not assigned | |
| T1 | Transformer | ABA-LGSEE-5 |

UNIQUE PARTS (Cont.)

MODEL LGS-EE-6-OV-R

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| C3 | Cap., elect., 100,000 mf -10 +50%, 7.5 vdc | CBV-10-003 |
| C111, C112 | Not assigned | |
| C121 | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-119 |
| CR148 | Not assigned | |
| HC1 | Hybrid circuit | L-20-OV-6 |
| L1 | Filter choke | BBA-LGSEE-5 |
| R3 | Res., comp., 12 ohms ±10%, 1 w | DGB-1201 |
| R9 | Res., ww, 25 ohms ±3%, 5w | DFP-25-066 |
| R10 | Res., ww, 16 ohms ±5%, 40 w | DFP-16-055 |
| R19 | Res., var., cermet, 5,000 ohms ±20%, 1 w | DRS-50-010 |
| R108 | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110†† | Res., comp., 22,000 ohms ±10%, ¼ w | DCB-2231 |
| R119 | Not assigned | |
| R120 | Res., film, 20 ohms ±5%, ½ w | DCP-20-026 |
| R131 thru R134, R137 | Not assigned | |
| T1 | Transformer | ABA-LGSEE-6 |

MODEL LGS-EE-12-OV-R

| | | |
|---|---|---|
| C3 | Cap., elect., 65,000 mf -10 +50%, 15 vdc | CBT-65-053 |
| C111* | Cap., mylar, 0.1 mf ±10%, 200 vdc | CAM-10-012 |
| C112* | Cap., mylar, 0.47 mf ±10%, 200 vdc | CGM-47-016 |
| C121† | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-118 |
| CR148* | Rectifier | FBL-00-082 |
| HC1 | Hybrid circuit | L-20-OV-12 |
| L1 | Filter choke | BBA-LGSEE-12 |
| Q107* | Transistor, PNP | FBN-L118 |
| Q108* | Transistor, NPN | FBN-L110 |
| R3 | Res., comp., 33 ohms ±10%, 1 w | DGB-3301 |
| R9 | Res., ww, 100 ohms ±3%, 5 w | DFR-10-025 |
| R10 | Res., ww, 25 ohms ±5%, 40 w | DFP-25-056 |
| R19 | Res., var., cermet, 5,000 ohms ±20%, 1 w | DRS-50-010 |
| R108† | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110 | Res., comp., 68,000 ohms ±10%, ¼ w | DCB-6831 |
| R119 | Res., film, 7,500 ohms ±1%, ¼ w | DCS-75-072 |
| R120 | Res., film, 20 ohms ±5%, ½ w | DCP-20-026 |
| R131* | Res., comp., 47,000 ohms ±10%, ½ w | DEB-4731 |



†† R110 was 68,000 ohms ±10%, ¼w, DCB-6831 on units with serial no. prefixes A-F.

UNIQUE PARTS (Cont.)

MODEL LGS-EE-12-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| R132* | Res., comp., 10,000 ohms ±10%, ½ w | DEB-1031 |
| R133* | Same as R131 | |
| R134* | Res., comp., 68 ohms ±10%, ½ w | DEB-6801 |
| R135* | Same as R132 | |
| R137* | Res., comp., 100,000 ohms ±10%, ½ w | DEB-1041 |
| T1 | Transformer | ABA-LGSEE-12 |

* Not used on units with serial no. prefixes A—D.

† Only used on units with serial no. prefixes A—D.

MODEL LGS-EE-15-OV-R

| | | |
|---|---|---|
| C3 | Cap., elect., 55,000 mf -10 +50%, 17.5 vdc | CBT-55-054 |
| C111* | Cap., mylar, 0.1 mf ±10%, 200 vdc | CAM-10-012 |
| C112* | Cap., mylar, 0.47 mf ±10%, 200 vdc | CGM-47-016 |
| C121† | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-118 |
| CR148* | Rectifier | FBL-00-082 |
| HC1 | Hybrid circuit | L-20-OV-15 |
| L1 | Filter choke | BBA-LGSEE-15 |
| Q107* | Transistor, PNP | FBN-L118 |
| Q108* | Transistor, NPN | FBN-L110 |
| R3 | Res., comp., 33 ohms ±10%, 1 w | DGB-3301 |
| R9 | Res., ww, 110 ohms ±3%, 5 w | DFR-11-115 |
| R10 | Res., ww, 25 ohms ±5%, 40 w | DFP-25-056 |
| R19 | Res., var., cermet, 5,000 ohms ±20%, 1 w | DRS-50-010 |
| R108† | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110 | Res., comp., 68,000 ohms ±10%, ¼ w | DCB-6831 |
| R119 | Res., film, 10,000 ohms ±1%, ¼ w | DCT-10-047 |
| R120 | Res., film, 20 ohms ±5%, ½ w | DCP-20-026 |
| R131* | Res., comp., 47,000 ohms ±10%, ½ w | DEB-4731 |
| R132* | Res., comp., 10,000 ohms ±10%, ½ w | DEB-1031 |
| R133* | Same as R131 | |
| R134* | Res., comp., 68 ohms ±10%, ½ w | DEB-6801 |
| R135* | Same as R132 | |
| R137* | Res., comp., 100,000 ohms ±10%, ½ w | DEB-1041 |
| T1 | Transformer | ABA-LGSEE-15 |

* Not used on units with serial no prefixes A—D.

† Only used on units with serial no. prefixes A—D.

UNIQUE PARTS (Cont.)

MODEL LGS-EE-20-OV-R

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| C3 | Cap., elect., 45,000 mf -10 +50%, 25 vdc | CBT-45-055 |
| C111* | Cap., mylar, 0.1 mf ±10%, 200 vdc | CAM-10-012 |
| C112* | Cap., mylar, 0.47 mf ±10%, 200 vdc | CGM-47-016 |
| C121† | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-118 |
| CR148* | Rectifier | FBL-00-082 |
| HC1 | Hybrid circuit | L-20-OV-20 |
| L1 | Filter choke | BBA-LGSEE-20 |
| L13 | I bar | TCI-460-003 |
| | U core | TCU-460-002 |
| Q107* | Transistor, PNP | FBN-L118 |
| Q108* | Transistor, NPN | FBN-L110 |
| R3 | Res., comp., 47 ohms ±10%, 1 w | DGB-4701 |
| R9 | Res., ww, 150 ohms ±5%, 10w | DFR-15-116 |
| R10 | Res., ww, 25 ohms ±5%, 40 w | DFP-25-056 |
| R19 | Res., var., cermet, 10,000 ohms ±10%, 1 w | DRT-10-042 |
| R108† | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110 | Res., comp., 100,000 ohms ±10%, ¼ w | DCB-1041 |
| R119 | Res., film, 13,300 ohms ±1%, ¼ w | DCT-13-067 |
| R120 | Res., film, 27 ohms ±5%, ¼ w | DCP-27-023 |
| R131* | Res., comp., 47,000 ohms ±10%, ½ w | DEB-4731 |
| R132* | Res., comp., 10,000 ohms ±10%, ½ w | DEB-1031 |
| R133* | Same as R131 | |
| R134* | Res., comp., 68 ohms ±10%, ½ w | DEB-6801 |
| R135* | Same as R132 | |
| R137* | Res., comp., 100,000 ohms ±10%, ½ w | DEB-1041 |
| T1 | Transformer | ABA-LGSEE-20 |

* Not used on units with serial no prefixes A—D.

† Only used on units with serial no. prefixes A—D.

MODEL LGS-EE-24-OV-R

| | | |
|---|---|---|
| C3 | Cap., elect., 32,000 mf -10 +50%, 30 vdc | CBT-32-056 |
| C111* | Cap., mylar, 0.1 mf ±10%, 200 vdc | CAM-10-012 |
| C112* | Cap., mylar, 0.47 mf ±10%, 200 vdc | CGM-47-016 |
| C121† | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-118 |
| CR148* | Rectifier | FBL-00-082 |

UNIQUE PARTS (Cont.)

MODEL LGS-EE-24-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| HC1 | Hybrid circuit | L-20-OV-24 |
| L1 | Filter choke | BBA-LGSEE-24 |
| L13 | I bar | TCI-460-003 |
| | U core | TCU-460-002 |
| Q107* | Transistor, PNP | FBN-L118 |
| Q108* | Transistor, NPN | FBN-L110 |
| R3 | Res., comp., 47 ohms ±10%, 1 w | DGB-4701 |
| R9 | Res., ww, 150 ohms ±5%, 10w | DFR-15-116 |
| R10 | Res., ww, 25 ohms ±5%, 40 w | DFP-25-056 |
| R19 | Res., var., cermet, 10,000 ohms ±10%, 1 w | DRT-10-042 |
| R108† | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110 | Res., comp., 100,000 ohms ±10%, ¼ w | DCB-1041 |
| R119 | Res., film, 18,200 ohms ±1%, ¼ w | DCT-18-068 |
| R120 | Res., film, 27 ohms ±5%, ¼ w | DCP-27-023 |
| R131* | Res., comp., 47,000 ohms ±10%, ½ w | DEB-4731 |
| R132* | Res., comp., 10,000 ohms ±10%, ½ w | DEB-1031 |
| R133* | Same as R131 | |
| R134* | Res., comp., 68 ohms ±10%, ½ w | DEB-6801 |
| R135* | Same as R132 | |
| R137* | Res., comp., 100,000 ohms ±10%, ½ w | DEB-1041 |
| T1 | Transformer | ABA-LGSEE-24 |

* Not used on units with serial no. prefixes A—D.

† Only used on units with serial no. prefixes A—D.

MODEL LGS-EE-28-OV-R

| | | |
|---|---|---|
| C3 | Cap., elect., 32,000 mf -10 +50%, 30 vdc | CBT-32-056 |
| C111* | Cap., mylar, 0.1 mf ±10%, 200 vdc | CAM-10-012 |
| C112* | Cap., mylar, 0.47 mf ±10%, 200 vdc | CGM-47-016 |
| C121† | Cap., mylar, 0.33 mf ±10%, 80 vdc | CGM-33-012 |
| CR1 thru CR4 | Rectifier | FBL-00-118 |

UNIQUE PARTS (Cont.)

MODEL LGS-EE-28-OV-R (Cont.)

| CIRC. DESIG. | DESCRIPTION | LAMBDA NO. |
|---|---|---|
| CR148* | Rectifier | FBL-00-082 |
| HC1 | Hybrid circuit | L-20-OV-28 |
| L1 | Filter choke | BBA-LGS-EE-28 |
| L13 | I bar | TCI-460-003 |
| | U core | TCU-460-002 |
| Q107* | Transistor, PNP | FBN-L118 |
| Q108* | Transistor, NPN | FBN-L110 |
| R3 | Res., comp., 47 ohms ±10%, 1 w | DGB-4701 |
| R9 | Res., ww, 220 ohms ±3%, 10w | DFR-22-118 |
| R10 | Res., ww, 25 ohms ±5%, 40 w | DFP-25-056 |
| R19 | Res., var., cermet, 10,000 ohms ±10%, 1 w | DRT-10-042 |
| R108† | Res., comp., 1,500 ohms ±10%, ½ w | DEB-1521 |
| R110 | Res., comp., 100,000 ohms ±10%, ¼ w | DCB-1041 |
| R119 | Res., film, 20,000 ohms ±1%, ¼ w | DCT-20-053 |
| R120 | Res., film, 27 ohms ±5%, ¼ w | DCP-27-023 |
| R131* | Res., comp., 47,000 ohms ±10%, ½ w | DEB-4731 |
| R132* | Res., comp., 10,000 ohms ±10%, ½ w | DEB-1031 |
| R133* | Same as R131 | |
| R134* | Res., comp., 68 ohms ±10%, ½ w | DEB-6801 |
| R135* | Same as R132 | |
| R137* | Res., comp., 100,000 ohms ±10%, ½ w | DEB-1041 |
| T1 | Transformer | ABA-LGSEE-28 |

* Not used on units with serial no prefixes A—D.

† Only used on units with serial no. prefixes A—D.

PARTS FOR "V" OPTION

On all LGS-EE models with suffix "V", C29 is added and R110 changes value on models LGS-EE-5-OV-R and LGS-EE-6-OV-R. Part no. changes and additions are listed here.

ALL MODELS

| | | |
|---|---|---|
| F1 | Fuse, 10A, 3AB, NORM-BLO | FFJ-10-000 |
| C29+ | Cap., ceramic, 0.01 mf ±20%, 1000 vdc | CDL-10-004 |
| R110+ | Res., comp., 22,000 ohms ±10%, 1/4w | DCB-2231 |

+ On units with serial no. prefixes A-F C29 not used. R110 was 68,000 ohms on 5v and 6v units.

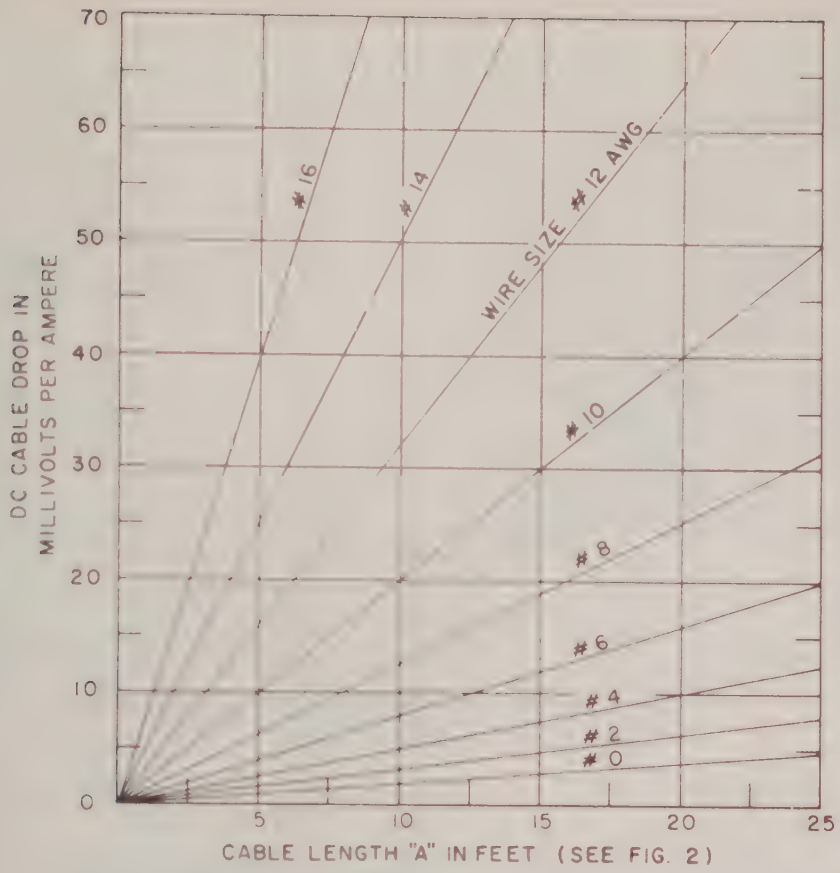



Figure 1. Cable Connection Chart

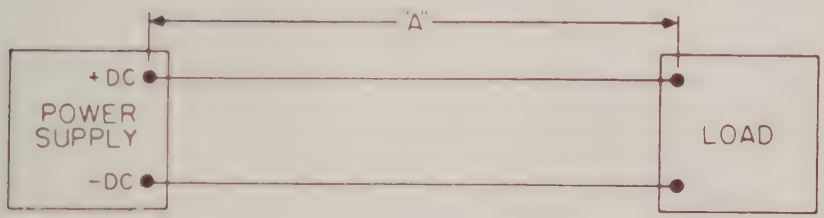



Figure 2. Cable Length "A" in Feet

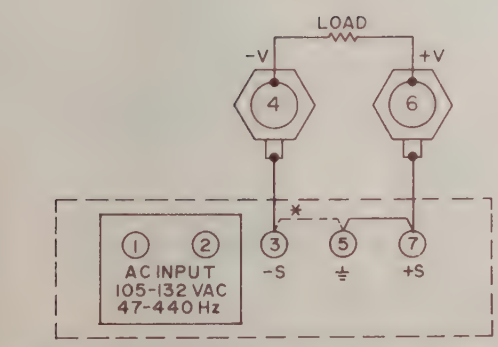



Figure 3. Local Sensing Connections

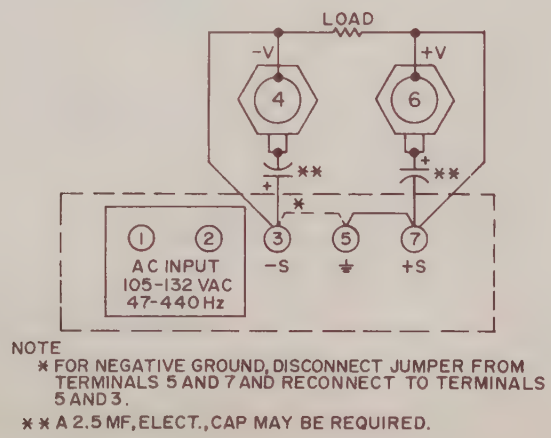



Figure 4. Remote Sensing Connections

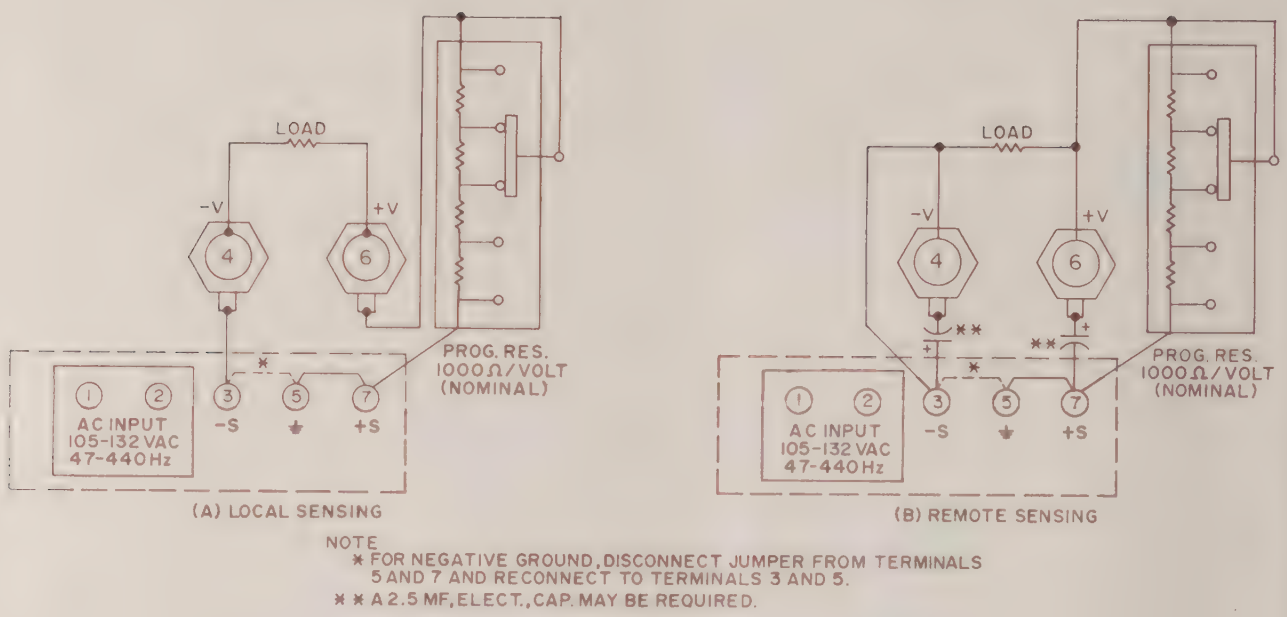



Figure 5. Programmed Voltage, with External Resistor.

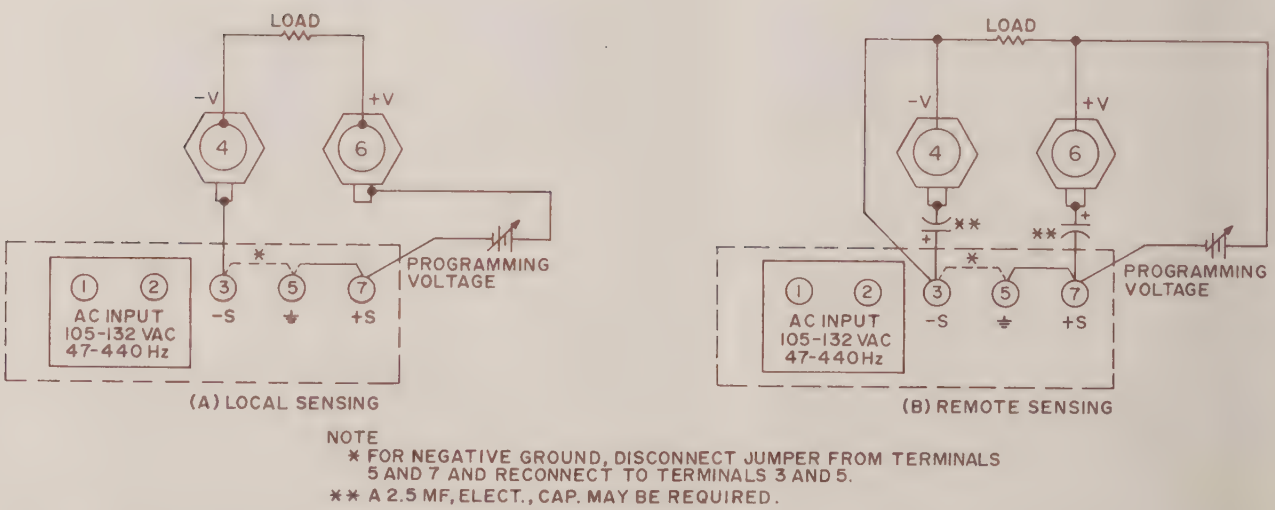
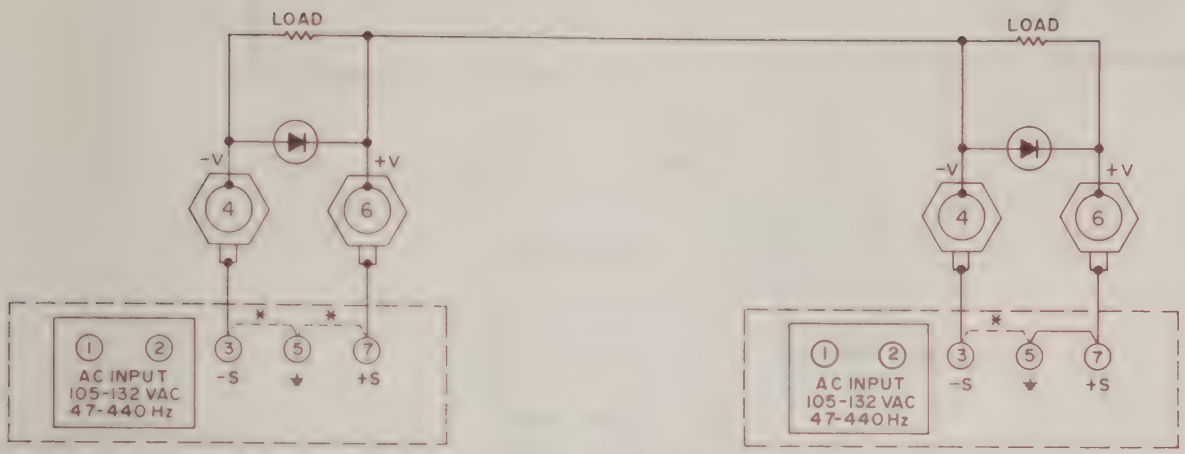
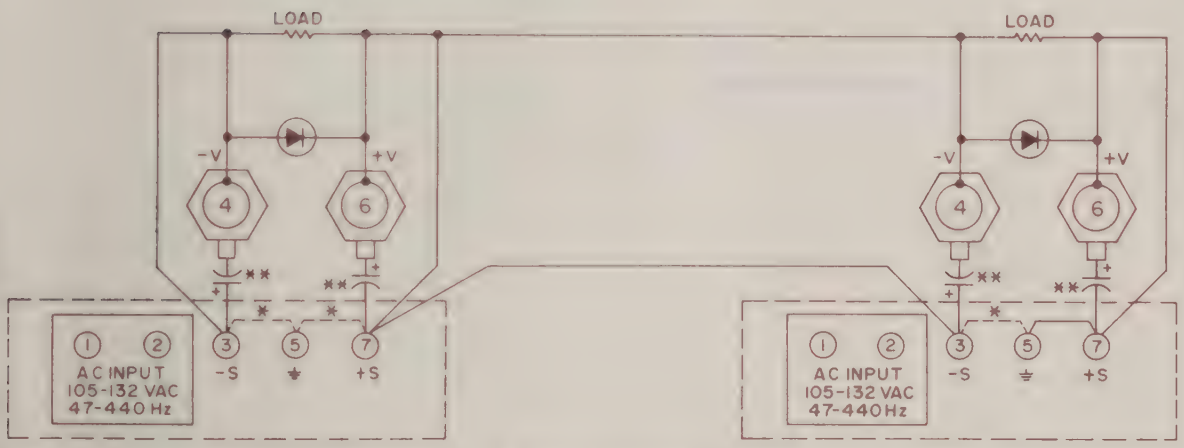



Figure 6. Programmed Voltage, with External Programming Voltage Source




(A) LOCAL SENSING




(B) REMOTE SENSING

NOTE:

* MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 7 ON RIGHT UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 7. Series Connection

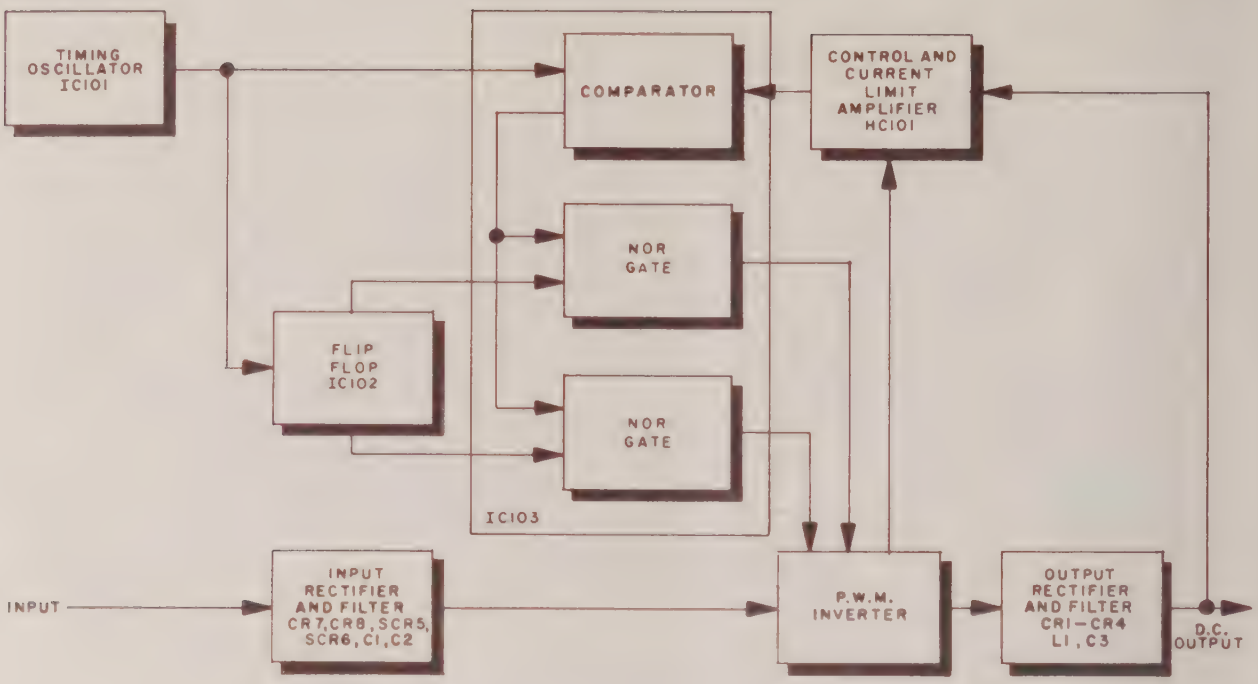
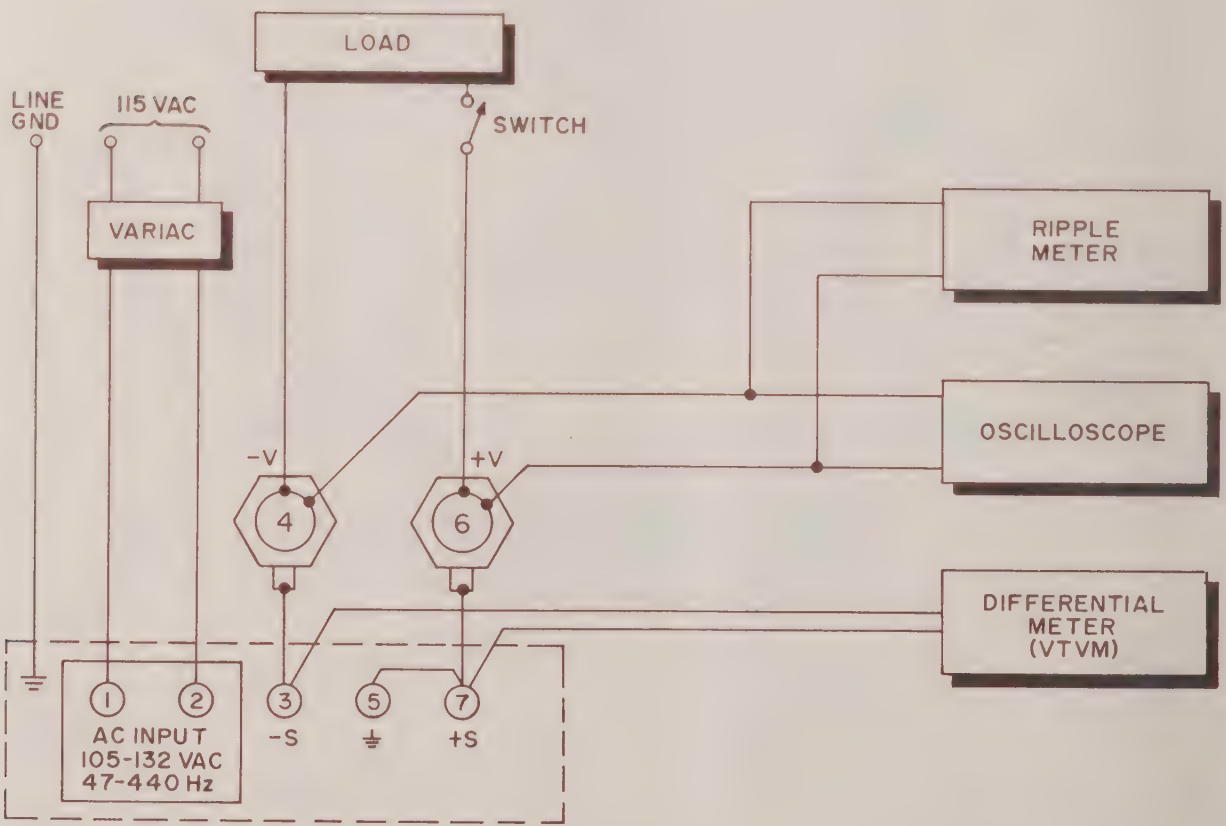



Figure 8. Typical Block Diagram




NOTES

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTION ONLY

Figure 9. Test Connections for Performance Checks

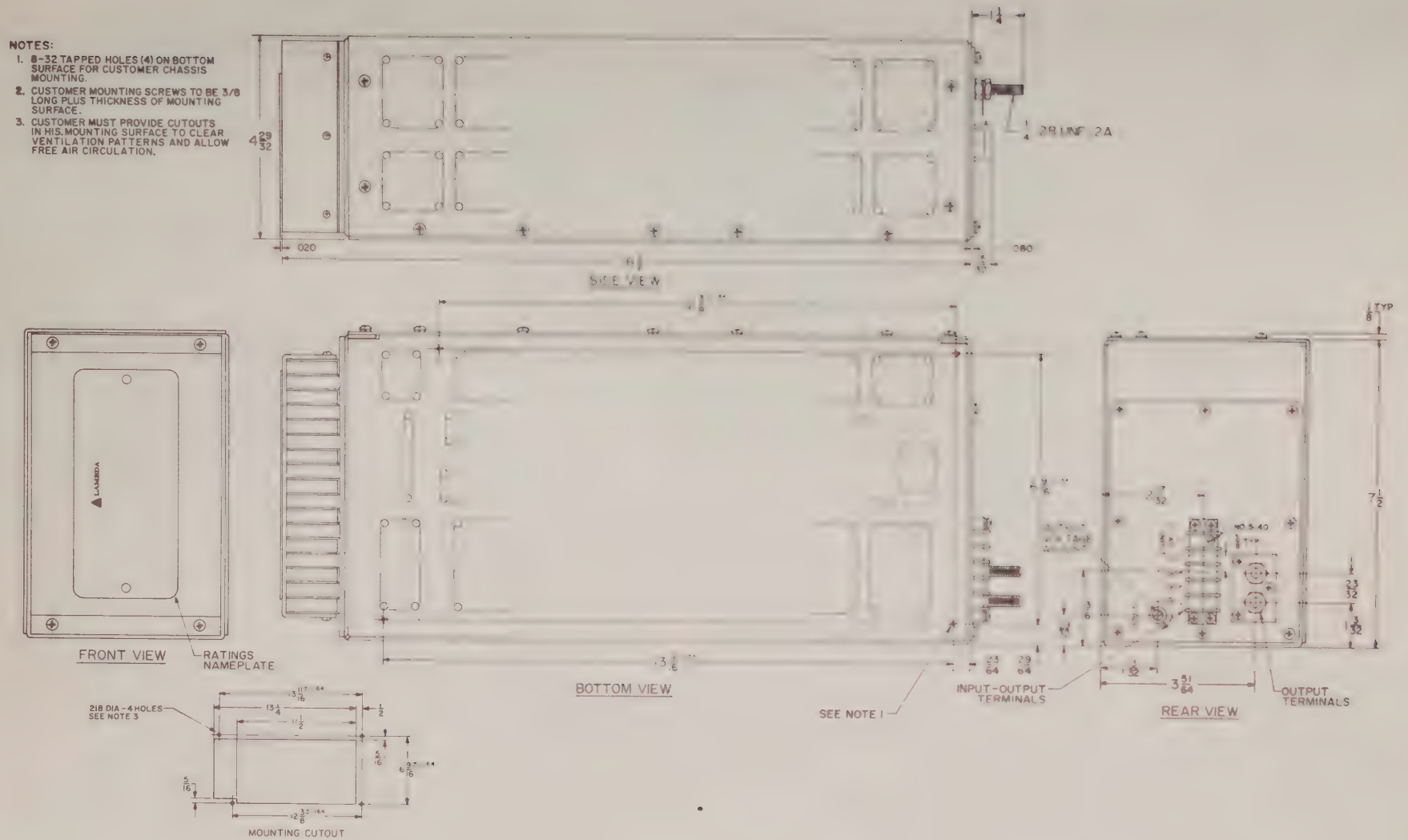
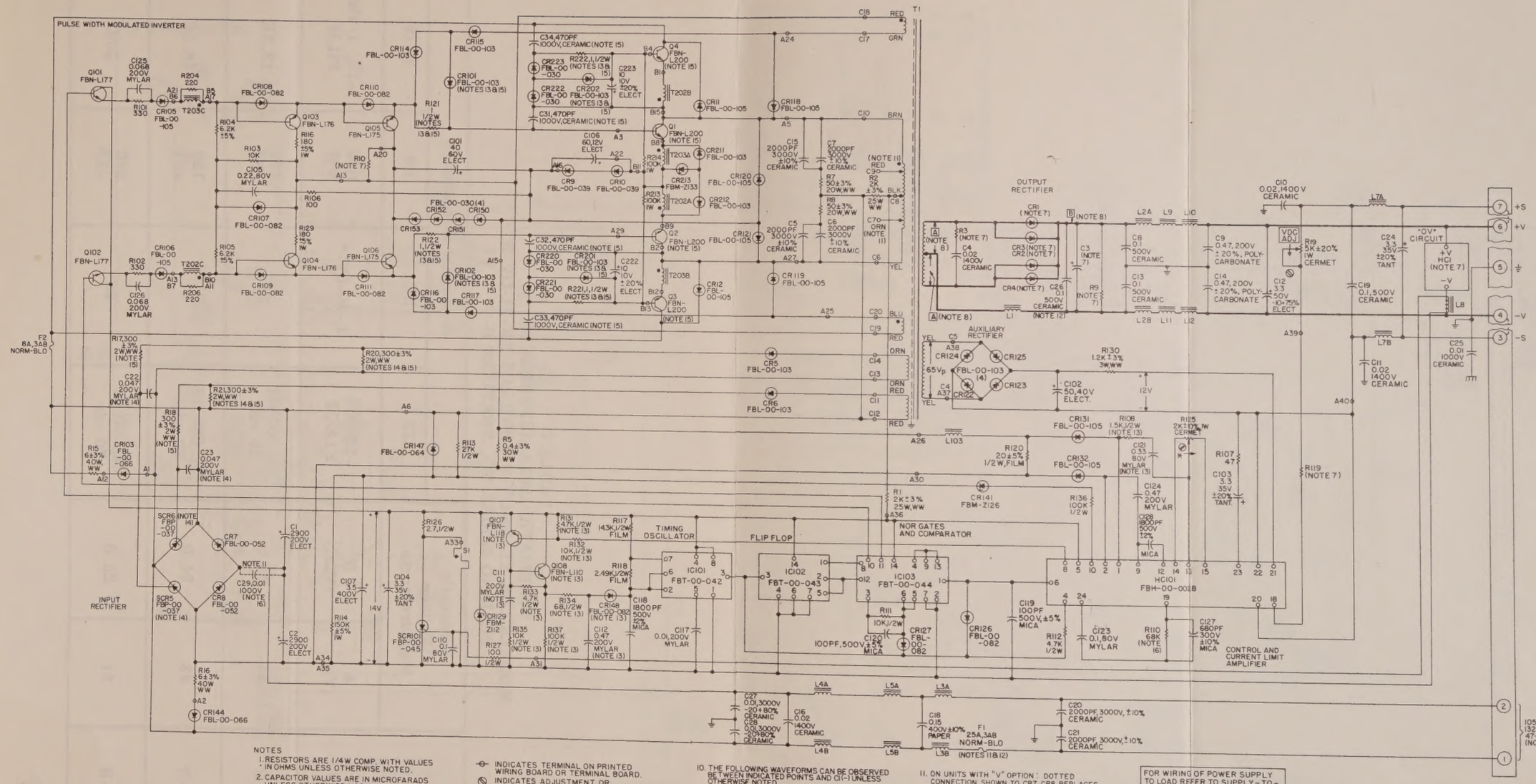



Figure 10. Outline Drawing

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-EE-5-0V-R THRU LGS-EE-15-0V-R
BEARING SERIAL NO. PREFIXES B-G

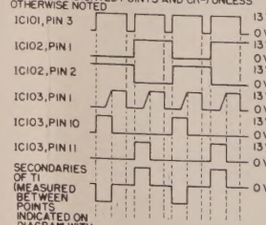
| Models | Schematic Voltage Measurements | | Schematic Components | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | C3 | CR1-CR4 | HC1 | R3 | R9 | R10 | R119 |
| | A (Vp) | B (VDC) | -10± 50% ELECT | FBL-00-* | L-20-0V-* | +10%, 1w COMP | ±3% WW | ±5%, 40w WW | ±1%, 1/4w FILM |
| LGS-EE-5-0V-R | 11 | 5.0 | 100,000 mf 7.5 vdc | 119 | 5 | 12 | 25 5W | 16 | Jumper |
| LGS-EE-6-0V-R | 13 | 6.0 | 100,000 mf 7.5 vdc | 119 | 6 | 12 | 25 5W | 16 | Jumper |
| LGS-EE-12-0V-R | 22 | 12.0 | 65,000 mf 15 vdc | 118 | 12 | 33 | 100 5W | 25 | 7.5K |
| LGS-EE-15-0V-R | 31 | 15.0 | 55,000 mf 17.5 vdc | 118 | 15 | 33 | 110 5W | 25 | 10K |

* Lambda part no.




NOTES

1. RESISTORS ARE 1/4W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%, FILM ±1%, WIREWOUND ±5%.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10 +100%, CERAMIC ±20%, MYLAR ±10%, UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ✱ SEE INSTRUCTION MANUAL
   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. SEE TABLE I FOR COMPONENT VALUES.
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 57-63 Hz, NOMINAL VOLTAGE NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER. AC MEASUREMENTS ARE PEAK VALUES MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND -S (TERM. 3) UNLESS OTHERWISE NOTED.
10. THE FOLLOWING WAVEFORMS CAN BE OBSERVED BETWEEN INDICATED POINTS AND CI(-) UNLESS OTHERWISE NOTED




11. ON UNITS WITH "V" OPTION: DOTTED CONNECTION SHOWN TO CR7, CR8 REPLACES CONNECTION TO C1, C2; F1 IS 10A, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TERMINALS C7 AND C9) OR FOR 205-265V INPUT (USING TERMINALS C6 AND C10).
12. ON UNITS WITH SERIAL NO. PREFIXES B&C, F1 IS 20A. C26 ONLY USED ON UNITS WITH SERIAL NO. PREFIXES B&C.
13. ON UNITS WITH SERIAL NO. PREFIX B-D: CR101, CR102, CR201, CR202 ARE NOT USED, R121, R122, R221, R222 ARE JUMPERS, C111, C112, CR148, Q107, Q108, R131, R132, R133, R134, R135, R137 ARE ONLY USED ON MODELS LGS-EE-12-OV-R AND LGS-EE-15-OV-R WITH SERIAL NO. PREFIXES FROM E ON. C121 AND R108 ARE NOT USED ON THESE UNITS.
14. ON UNITS WITH SERIAL NO. PREFIXES A-E: SCR5 AND SCR6 ARE FBP-00-046; R20, R21, C22 AND C23 ARE NOT USED.
15. ON UNITS WITH SERIAL NO. PREFIX F: R20, R21 ARE 100 OHM 1/2W COMP; ON UNITS WITH SERIAL NO. PREFIXES A-E: R17, R18 ARE 100 OHM 1/2W COMP.; Q1 THRU Q4 ARE FBN-L195, ON UNITS WITH SERIAL NO. PREFIX G: C31 THRU C34, CR101, CR102, CR201, CR202 ALL ARE NOT USED; R121, R122, R221, R222 ARE NO.22 AWG JUMPERS.
16. ON UNITS WITH "V" OPTION AND SERIAL NO. PREFIXES A-F: C29 NOT USED; ON STD UNITS AND WITH "V" OPTION AND SERIAL NO. PREFIX G: R110 IS 22,000 OHMS ON 5V AND 6V UNITS.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TBI INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES B-G

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

| MODELS |
|---|
| LGS-EE-5-OV-R |
| LGS-EE-6-OV-R |
| LGS-EE-12-OV-R |
| LGS-EE-15-OV-R |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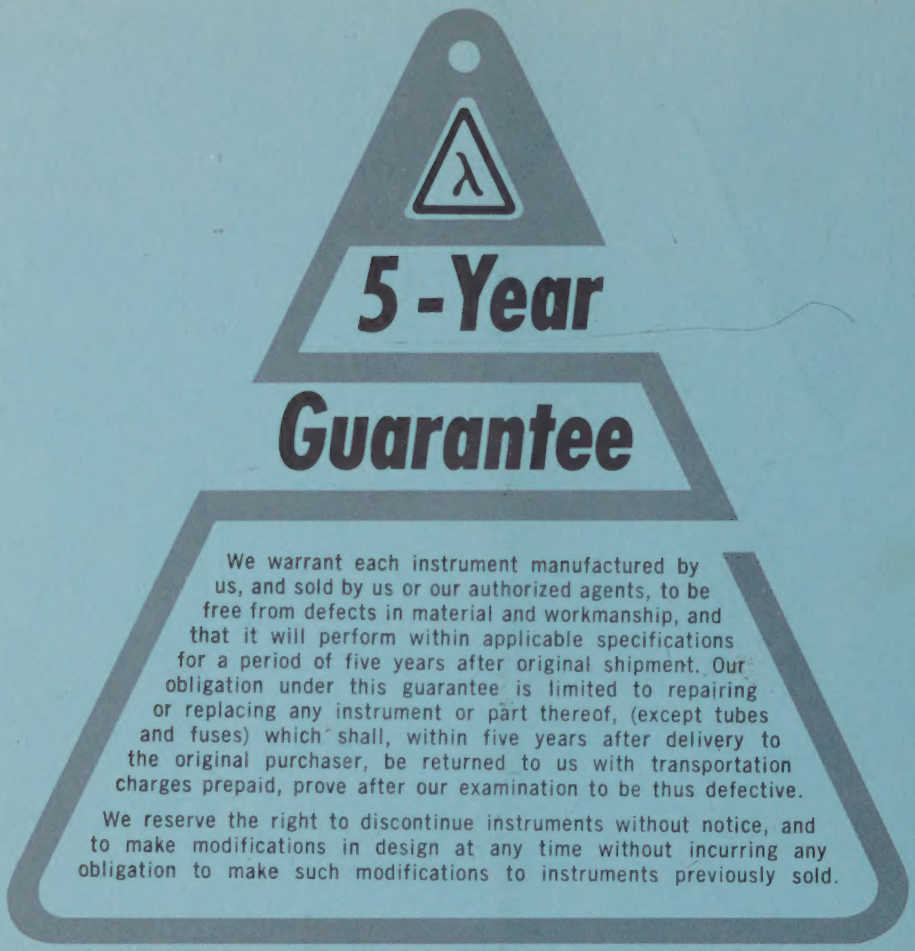


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